Abstract

The present invention provides a non-cyanide aqueous acidic immersion plating solution having a pH of from about 3.5 to about 6.5 and comprising zinc ions, nickel ions and/or cobalt iron ions, and fluoride ions. In one embodiment the immersion plating solutions of the invention also contain at least one inhibitor containing one or more nitrogen atoms, sulfur atoms, or both nitrogen and sulfur atoms. The present invention also relates to methods for depositing zinc alloy protective coatings on aluminum and aluminum alloy substrates comprising immersing the aluminum or aluminum alloy substrate in the non-cyanide acidic immersion plating solutions of the invention. Optionally, the zinc alloy coated aluminum or aluminum alloy substrate is plated using an electroless or electrolytic metal plating solution.